

The greatest monthly precipitation was 20.47 inches at Branscomb. At two stations no precipitation was reported during the month. The greatest 24-hour rainfall was 5.40 inches at Mono Ranch on the 15th.

*Snowfall.*—There was a moderate snowfall in the mountains, and at the close of the month more snow remained on the ground than at the same date last year and about as much as in 1908. There was less snow than in 1909 and 1911. The month was so cold there was less melting and also less evaporation than usual. The run-off was light, and at nearly all points streams were lower than usual. The following table shows the depth of snow on the ground at Summit, Cal., on certain dates in January during the period 1907 to date:

	Jan. 1.	Jan. 15.	Jan. 31.
	Inches.	Inches.	Inches.
1907.....	45	142	148
1908.....	87	72	87
1909.....	28	90	172
1910.....	54	87	68
1911.....	4	136	218
1912.....	60	46	41
1913.....	17	72	88

#### SUNSHINE.

The following table gives the total hours of sunshine and percentages of the possible:

Stations.	Hours.	Percent- age of possible.	Stations.	Hours.	Percent- age of possible.
Eureka.....	153	45	Sacramento.....	192	63
Fresno.....	178	58	San Diego.....	230	72
Los Angeles.....	223	71	San Francisco.....	156	60
Mount Tamalpais.....	194	63	San Jose.....	194	63
Red Bluff.....	182	60	San Luis Obispo.....	193	62

#### CHANGES IN NAMES OF STATIONS.

The following changes have been made in the names of stations, and the new names are used, beginning with the present issue:

Bear Valley No. 1 changes to Lake Spaulding.  
Prattville changes to Neviss.

#### NOTES ON THE RIVERS OF THE SACRAMENTO AND LOWER SAN JOAQUIN WATERSHEDS DURING JANUARY, 1913.

By N. R. TAYLOR, Local Forecaster.

*Sacramento Watershed.*—The rivers of this watershed averaged from 1 foot to over 5 feet above that of the preceding month. They were, however, below the stages usually maintained during the month of January.

General and heavy rains fell in the watersheds of the Upper Sacramento and Lower Pit rivers from the 12th to the 19th, inclusive, with considerable snow at low altitudes, causing a rapid rise in the Sacramento River north of the Feather. At Red Bluff the river rose 13 feet during the 24 hours ending at 7 a. m., of the 14th. This swell reached Jacinto on the 15th and Colusa on the 16th, causing rises of 7 and 11 feet, respectively, at those places. The swell flattened as the lower reaches of the river were approached and amounted to only 4 feet at Sacramento City. The highest stage reached was 21.9 feet at Colusa on the 16th.

The rainfall in the American, Feather, and Yuba watersheds was coincident with that of the Sacramento, except that there was considerably less. There was, however, a heavy snowfall above the 2,000-foot level and

especially in the higher regions, but owing to the prevailing low temperatures neither the main streams nor their feeders showed any marked increase in run-off.

On about the 20th all streams in the Sacramento Basin began falling and continued to do so until the close of the month.

At the end of January the accumulated snow in the mountains ranged from about 18 inches at the 4,000-foot level to nearly 8 feet at the summits.

*The Lower San Joaquin Watershed.*—Rain was general throughout the drainage basin of the Lower San Joaquin Valley from about the 14th to the 20th, inclusive. It was heavy in the upper watersheds of the Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes with heavy snow at the higher levels. On the floor of the valley the rainfall was relatively light, especially north of San Joaquin Bridge. Notwithstanding the rainfall the rivers remained low during the greater part of the month and there was no rise at any time greater than 1 foot.

After the 20th all streams fell slowly and by the close of the month had practically reached the low stages that obtained prior to the rains.

#### NOTES ON THE STREAMS OF THE UPPER SAN JOAQUIN WATERSHED.

By W. E. BONNETT, Local Forecaster.

Rainfall during January, like that of the preceding several months, was largely deficient in the watershed of the Upper San Joaquin River, and the streams remained at low stages. The deficiency in seasonal precipitation about equals the shortage to January 31, 1912, and the mean stages at Merced Falls and Friant for January this year are the same as last year. At Firebaugh there was no fluctuation in the stream during the month and the stage was the lowest recorded in January.

Following the general rains of the 15th, 16th, and 17th the Merced rose about 1 foot and fell slowly during the remainder of the month. Precipitation was lighter in the watersheds of the Upper San Joaquin itself and in the Kings, and rises at Friant and Piedra were extremely small.

#### DAMAGE BY LIGHTNING NEAR SAN FRANCISCO.

By A. G. McADIE.

On January 15, 1913, shortly before 1 a. m., lightning struck the tower of the life-saving station at Bonita Point and did considerable damage. It set fire to the captain's room, but it was quickly extinguished; the damage was estimated about \$500. A flagpole, standing on somewhat higher ground to the northward, was also struck and partly destroyed. It may be stated that occurrences of this kind while rare are not unknown. At San Francisco the first thunder was heard at 12.01 a. m., and last at 1.15 a. m. The direction of the wind before the storm was southwest and after the storm south. The temperature before the storm, 52°, and after the storm, 42°.

#### NOTE ON WEATHER AT FRESNO, CAL., DURING JANUARY, 1913.

By W. E. BONNETT, Local Forecaster.

January was a month of abnormal and generally unfavorable conditions. A severe dust storm occurred on the 4th, when the wind increased during the forenoon to 30 miles per hour by noon, a velocity which was then maintained for about six hours, and a new wind record

for the month of January established when the maximum, 36 miles from the west, was recorded at 2.51 p. m. Owing to the dry condition of the soil the air filled with dust as the wind rose and the sky was entirely obscured by it during the whole afternoon, the disk of the sun being faintly visible only at times. The dust penetrated buildings of even the best construction, leaving a thick coating everywhere. Objects two city blocks distant were obscured. Besides making the day unpleasant, there was damage to wearing apparel, house furnishings, etc. The air was extremely dry and the per cent of humidity decreased to a midsummer minimum by 5 p. m., making the storm particularly damaging to vegetation. In loose, light soils some grain was blown out in places, while in other places it was buried under the wind-transported material. Considerable dust was held in suspension in the air during the 5th and 6th and the sun shone with a sickly light.

This unusual dryness had an important effect in producing the record-breaking freeze on succeeding days. The temperature fell during the 5th, and on the morning of the 6th a minimum of 17° was recorded at this station, 3° lower than the lowest previously recorded minimum in 26 years of record. Standard instruments on the ground recorded 14° and 15° on the 6th and 7th, respectively, and from lower portions of the valley floor readings of 10° and 12° were reported.

Citrus trees and citrus nursery stock were badly frozen, but not entirely killed, except the nursery stock in a few localities. Practically all of the fruit remaining on the trees was completely frozen, a small proportion of the whole crop, as nearly all had been marketed. However, a full year's growth on citrus trees was frozen and will have to be pruned away. Eucalyptus of several varieties, acacias, and pepper trees were frozen severely and the younger trees killed. Ice 2 inches thick formed in considerable volume. A film of ice formed on irrigation ditches in places, a phenomenon which had not been observed here for many years. Much damage was occasioned by frozen water pipes, one plumber alone reporting that 200 calls were made to repair that class of plumbing troubles.

The month closed with some very pleasant but unseasonably warm weather, and the temperature deficiency for the month as a whole is not large. Rainfall for the month was about three-fourths of the normal amount and up to the 31st but one-half of the normal seasonal amount has been received.

#### REPORT ON RECENT DESTRUCTIVE FROSTS IN CALIFORNIA.

By Prof. A. G. MCADIE.

For many years the Weather Bureau had advised citrus-fruit growers of California that widespread injury might result in unprotected orchards when conditions out of the usual occurred; and that preparation should be made even in the most favored localities for temperatures as low as 24° F. It was pointed out that there had been many dates in the past 35 years when weather conditions were so severe as to cause injury to citrus fruits. The following table shows how frequently such low temperatures have occurred:

1878, Dec. 14.	1889, Jan. 19.	1906, Jan. 1.
1879, Dec. 25.	1894, Jan. 6, 7.	1907, Jan. 2.
1880, Jan. 29, 30, 31.	1897, Dec. 19, 21.	1910, Jan. 6.
1882, Feb. 18.	1898, Jan. 26.	1911, Feb. 16.
1883, Jan. 20, 21.	1901, Dec. 13.	1911, Dec. 25, 26.
1883, Feb. 3, 4, 6.	1902, Dec. 26.	1912, Dec. 23-30.
1886, Jan. 6.	1903, Feb. 14, 15.	1913, Jan. 4, 5, 6, 7.
1888, Jan. 7, 8, 9, 10.	1904, Jan. 21.	

It is somewhat difficult to determine what constitutes a dangerous temperature in connection with citrus fruits, inasmuch as most temperature records have been made in shelters and do not fairly represent the temperature to which fruit is exposed. At San Diego and Los Angeles the recorded values at the Weather Bureau offices are from 5° to 10° above those made in the orange groves a few miles distant, and there appears to be an increase in this difference with distance from the coast. Again, temperature varies with height above the ground and inversions are frequently found during winter mornings. An instrument placed near the top of a tree will generally give a temperature much higher than one placed near the ground. Furthermore, the freezing point commonly used is not necessarily the freezing point for water in the plant. Finally, injury is probably determined more by the rate of warming up after the blossom or fruit has been subjected to a freezing temperature than by the fall in temperature. In other words, defrosting is a matter of the utmost importance.

Oranges and lemons are commercially grown in Florida and in portions of Louisiana, as well as in California; but the extent of the industry in California may be judged from the following table, which shows the shipment of citrus fruit from the whole State for the past 19 years:

Season.	Carloads.	Season.	Carloads.
1894-95.....	7,575	1904-5.....	31,422
1895-96.....	6,915	1905-6.....	27,610
1896-97.....	7,350	1906-7.....	29,820
1897-98.....	15,400	1907-8.....	32,729
1898-99.....	10,875	1908-9.....	40,516
1899-1900.....	18,400	1909-10.....	33,099
1900-1.....	24,900	1910-11.....	46,594
1901-2.....	19,180	1911-12.....	36,283
1902-3.....	23,875	1912-13.....	
1903-4.....	29,399		

The above data are in the main from the California Fruit Grower.

On December 24, 1912, the crop was estimated at 48,000 carloads. Within a week from this time the injury had been so great that now no reliable estimate can be made. A somewhat similar condition occurred during the preceding year. Estimates of the crop of 1911-12, made previous to the frost of December 25-26, made the crop 50,000 carloads. It is generally conceded that the money loss caused by the frosts in the closing week of 1911 amounted to \$5,000,000. The loss during the last week of December, 1912, and the first week of January, 1913, may exceed \$15,000,000.

In both of these periods ample warning of the fall in temperature was given, and in some localities intelligent and well-directed effort was made to prevent the lowering of the temperature. This was particularly the case at Pomona, where the orchardists are organized under the lead of Mr. J. E. Adamson, in a protective association. The methods employed were described in the Monthly Weather Review for July, 1912. Reports are received hourly, or oftener if necessary, during the early night at a central station, and a tag for each report is placed upon a large map of the district in its proper place. It is thus possible to estimate the rate of change in temperature; and to order the necessary firing, which is done by the force under the direction of the general manager. Records show a rise in temperature of 6° one hour after firing.

The protective devices used are oil burners of simple construction, the fuel being a low grade of distillate. As originally used, these burners did not consume all of the carbon, but gave off a soot-laden smoke. The soot has been found to be not only extremely disagreeable,